IN THE MATTER OF
PATENT APPLICATION NO. 10/591,370
IN THE NAME OF NEC Corporation

DECLARATION

I, Yoshio Nagasaki, c/o YAMASHITA & ASSOCIATES of RANDIC TORANOMON BUILDING, 7-10, TORANOMON 3-CHOME, MINATO-KU, TOKYO, JAPAN, 105-0001, do solemnly and sincerely declare that I well understand the Japanese language and the English language and that the attached English translations of certified copies of Japanese Patent Applications No. 2004-058524, No. 2004-311977 and No. 2005-055961 are true, correct and faithful translations to the best of my knowledge and belief from the Japanese language into the English language.

Dated this 2nd day of October, 2009

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PATENT OFFICE
JAPANESE GOVERNMENT

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Date of Filing: October 27, 2004
Application Number: Application for Patent No. 2004-311977
Applicant: NEC Corporation

Date: December 21, 2004

HIROSHI OGAWA
Commissioner,
Patent Office

[Document Name] APPLICATION FOR PATENT

[Reference Number] 35001348

[Addressee] Commissioner of Patent Office

[IPC] H04L 12/28

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[Claim of Priority based on Previous Application]

[Application Number] Application for Patent No. 2004-058524

[Date of Filing] May 3, 2004

[Indication of Official Fee]

[Number of Deposit Account] 009265

[Amount of Payment] 16,000

[List of Attached Documents]

[Name of Document] Specification 1

[Name of Document] Drawings 1

[Name of Document] Abstract 1

[General Power of Attorney Number] 9715827

[Name of Document] CLAIMS

[Claim 1] A positioning system for detecting the position of a terminal, comprising:

a terminal configured to receive a unique information transmitted from an illumination device whose potation is given; and

position estimation means configured to estimate the position of the terminal based on the unique information received by the terminal.

[Claim 2] The positioning system according to claim 1, wherein

the unique information is illumination identification information for uniquely identifying the illumination device.

[Claim 3] The positioning system according to claim 1 or claim 2, wherein

the position estimation means is configured to:

manage illumination installation position information including the unique information and position information indicating the installation position of the illumination device in association with each other;

read out, from the illumination installation position information, the position information corresponding to the unique information received by the terminal; and

estimate the position of the terminal based on the read out position information.

[Claim 4] The positioning system according to any of claims 1 to 3, wherein

the illumination device comprises a light emission unit as an illumination; and a transmission unit for transmitting the unique information.

[Claim 5] The positioning system according to claim 4, wherein

the transmission unit transmits the unique information on a visible light signal using a white LED.

[Claim 6] The positioning system according to claim 4, wherein

the transmission unit transmits the unique information on an infrared ray signal using an infrared LED.

[Claim 7] The positioning system according to claim 4, wherein

the transmission unit transmits the unique information on a radio signal using a wireless communication unit.

[Claim 8] The positioning system according to any one of claims 4 to 7, wherein

the transmission unit transmits the unique information to the terminal at random timing.

[Claim 9] The positioning system according to any one of claims 4 to 8, wherein

each of the light emission unit and transmission unit is configured to be separatable from a

power source unit of the illumination device.

[Claim 10] The positioning system according to claim 9, wherein

each of the light emission unit and transmission unit is connected to the power source unit using a power source interface of a fluorescent tube for a fluorescent illumination device.

[Claim 11] The positioning system according to claim 10, wherein

each of the light emission unit and transmission unit incorporates a power conversion unit.

[Claim 12] The positioning system according to claim 11, wherein

the power conversion unit is configured to convert an AC power supplied from the power source interface of a fluorescent tube into a DC power used by the light emission unit and transmission unit.

[Claim 13] The positioning system according to claim 10, wherein

the light emission unit uses a fluorescent tube, and

the transmission unit incorporates the power conversion unit.

[Claim 14] The positioning system according to claim 13, wherein

the power conversion unit is configured to convert an AC power supplied from the power source interface of a fluorescent tube into a DC power used by the transmission unit.

[Claim 15] The positioning system according to claim 13, wherein

the power conversion unit comprises an overcurrent protection circuit for protecting the power source unit of the fluorescent illumination device.

[Claim 16] The positioning system according to claim 13, wherein

the power conversion unit comprises a power holding circuit for holding a power required for transmission of the unique information.

[Claim 17] The positioning system according to claim 13, wherein

two electrode terminals, which are the power source interface of a fluorescent tube, formed at one side of the fluorescent tube and power input terminals, which are connected to the power conversion unit for supplying a power to the transmission unit, are electrically connected in parallel to each other.

[Claim 18] The positioning system according to claim 17, wherein:

the fluorescent tube is a straight fluorescent tube having two electrode terminals respectively on both sides thereof;

the straight fluorescent tube further comprises a power acquisition unit which is connected in parallel to the two electrode terminals formed at one side thereof and acquires a power to be supplied to the power conversion unit; and

the power acquisition unit is formed into a plate having two holes through which the two electrode terminals are inserted.

[Claim 19] The positioning system according to claim 18, wherein

the power acquisition unit has a thickness of 1.3 mm or less.

[Claim 20] The positioning system according to claim 9, wherein

each of the light emission unit and transmission unit is connected to the power conversion unit using a power source interface of an incandescent light bulb for an incandescent light bulb illumination device.

[Claim 21] The positioning system according to claim 20, wherein

the light emission unit and transmission unit incorporate a power conversion unit.

[Claim 22] The positioning system according to claim 21, wherein

the power conversion unit is configured to convert a DC power voltage supplied from the power source interface of an incandescent light bulb into a voltage form that the light emission unit and transmission unit use.

[Claim 23] The positioning system according to any one of claims 4 to 8, wherein:

the illumination device comprises a solar battery unit; and

the transmission unit is configured to transmit the unique information by using a power supplied from the solar battery unit.

[Claim 24] The positioning system according to claim 23, wherein

the solar battery unit is configured to convert a light energy output from the light emission unit into an electrical power.

[Claim 25] The positioning system according to claim 23, wherein:

the illumination device comprises a rechargeable battery for storing a power supplied from the solar battery unit; and

the transmission unit is configured to transmit the unique information when a power required for the transmission of the information has been stored in the rechargeable battery.

[Claim 26] The positioning system according to any one of claims 4 to 25, wherein

the transmission unit is configured to determine an angle at which the unique information is transmitted depending on the size of the area within which the unique information can be received and installation level of the illumination device.

[Claim 27] The positioning system according to claim 26, wherein

the transmission unit comprises a plurality of LEDs for emitting a light signal, the LEDs being configured to transmit the unique information on the light signal in different directions.

[Claim 28] The positioning system according to claim 27, wherein

the transmission unit is configured to determine the number of LEDs that transmit the unique information depending on a difference in the transmission direction between the adjacent two LEDs, transmission angles of LEDs, size of the area within which the unique information can be received, and installation level of the illumination device.

[Claim 29] The positioning system according to any one of claims 1 to 28, wherein

the illumination device is configured to emit a light having a color indicating that it is transmitting the unique information.

[Claim 30] The positioning system according to any one of claims 1 to 28, wherein

the illumination device is configured to emit a light using different colors for each service type.

[Claim 31] The positioning system according to any one of claims 1 to 28, wherein

the illumination device is configured to emit a light using different colors for each service provider providing a service using the position information of the terminal.

[Claim 32] The positioning system according to claim 30 or claim 31, wherein

the illumination device is configured to illuminate the area within which the terminal can receive the unique information with an illumination light.

[Claim 33] The positioning system according to any one of claims 1 to 32, wherein

the illumination device comprises a storage unit for storing the unique information.

[Claim 34] The positioning system according to any one of claims 3 to 33, wherein

the illumination installation position information is configured to be created by associating the unique information collected by the terminal and installation position of the illumination device with each other.

[Claim 35] The positioning system according to any one of claims 1 to 34, wherein:

the positioning system further comprises a second positioning system; and

the positioning system and second positioning system can be operated in a switchable manner.

[Claim 36] The positioning system according to claim 35, wherein

the second positioning system is a positioning system using a wireless LAN.

[Claim 37] The positioning system according to claim 35 or claim 36, wherein

the positioning system is configured to identify the position of the terminal by using the unique information that the illumination device transmits, in the case where requested terminal position information is logical position information.

[Claim 38] The positioning system according to claim 35 or claim 36, wherein

the positioning system is configured to identify the position of the terminal by using the second positioning system, in the case where the positioning system could not identify the position of the terminal by using the unique information.

[Claim 39] The positioning system according to claim 35 or claim 36, wherein

the positioning system is configured to determine whether to identify the position of the terminal by using the unique information or by using the second positioning system, based on the type of the requested terminal position information.

[Claim 40] The positioning system according to any one of claims 1 to 39, wherein

the positioning system is configured to display acquired terminal position information.

[Claim 41] The positioning system according to claim 40, wherein

the positioning system is configured to switch a display method of position information depending on the accuracy of acquired terminal position information.

[Claim 42] The positioning system according to claim 40 or claim 41, wherein

the positioning system has a function of storing attribute information concerning the terminal and of displaying the position information of the terminal corresponding to specified attribute information.

[Claim 43] The positioning system according to claim 42, wherein

the positioning system is configured to store, as the attribute information of the terminal, a name of a department to which a terminal user belongs.

[Claim 44] The positioning system according to any one of claims 40 to 43, wherein

the positioning system is configured to display the terminal position information corresponding to a specified display condition.

[Claim 45] The positioning system according to claim 44, wherein

the positioning system is configured to specify, as the display condition, information of floors in which the terminal exists.

[Claim 46] The positioning system according to any one of claims 1 to 45, wherein

the illumination device comprises a rechargeable battery and is configured to transmit information by using a power supply from the rechargeable battery in the case where it cannot use a power source thereof.

[Claim 47] The positioning system according to any one of claims 1 to 46, wherein

the positioning system is configured to:

identify a user terminal in response to a position information request concerning a

user of the terminal; and

acquire the position information of the identified terminal.

[Claim 48] The positioning system according to claim 47, wherein

the positioning system is configured to select one terminal in order of priority set for the respective terminals to acquire the position information thereof, in the case where a plurality of the user terminals exist.

[Claim 49] The positioning system according to claim 48, wherein

the priority is configured to be determined based on the type of the terminal.

[Claim 50] The positioning system according to claim 48, wherein

the priority is configured to be determined such that the position information of the terminal using a wireless LAN has a higher priority.

[Claim 51] The positioning system according to claim 48, wherein

the priority is configured to be determined based on presence/absence of a response from the terminal.

[Claim 52]. The positioning system according to claim 48, wherein

the priority is configured to determined based on the use state of the terminal.

[Claim 53] A positioning method of a positioning system for detecting the position of a terminal, comprising:

receiving, by a terminal, the unique information transmitted from an illumination device whose position is given; and

estimating the position of the terminal based on the unique information received by the terminal.

[Claim 54] The positioning method according to claim 53, wherein

the unique information is illumination identification information for uniquely identifying the illumination device.

[Claim 55] The positioning method according to claim 53 or claim 54, further comprising:

storing illumination installation position information including the unique information and position information indicating the installation position of the illumination device in association with each other;

reading out the position information corresponding to the unique information from the stored illumination installation position information based on the unique information received by the terminal; and

estimating the position of the terminal based on the read out position information.

[Claim 56] The positioning method according to any one of claims 53 to 55, wherein

a white LED is used as a light emission source of the illumination device and the unique information is transmitted by using a visible light signal emitted by the white LED.

[Claim 57] The positioning method according to any one of claims 53 to 55, wherein

the unique information is transmitted by using an infrared ray signal emitted by an infrared LED.

[Claim 58] The positioning method according to any one of claims 53 to 55, wherein

the unique information is transmitted by using a radio signal.

[Claim 59] The positioning method according to any one of claims 53 to 58, wherein

the unique information is transmitted to the terminal at random timing by the illumination device.

[Claim 60] The positioning method according to any one of claims 53 to 59, wherein

in the case where the light emission unit and transmission unit of the illumination device are connected to a power source unit by means of a power source interface of a fluorescent tube for a fluorescent illumination device, the light emission unit and transmission unit convert an AC power supplied from the power source interface of a fluorescent tube into a DC power.

[Claim 61] The positioning method according to any one of claims 53 to 59, wherein

in the case where the light emission unit and transmission unit of the illumination device are connected to a power source unit by means of a power source interface of an incandescent light bulb for an incandescent light bulb illumination device, the light emission unit and transmission unit convert a DC power voltage supplied from the power source interface of an incandescent light bulb into a voltage form that they can use.

[Claim 62] The positioning method according to any one of claims 53 to 61, further comprising

determining an angle at which the unique information is transmitted from the illumination device depending on the size of the area within which the unique information can be received and installation level of the illumination device.

[Claim 63] The positioning method according to any one of claims 53 to 62, further comprising

determining, in the case where a plurality of LEDs are arranged in the illumination device so as to emit the unique information in different directions, the number of LEDs that transmit the unique information depending on a difference in the transmission direction between the adjacent two LEDs, transmission angles of LEDs, size of the area within which the unique information can be received, and installation level of the illumination device.

[Claim 64] The positioning method according to any one of claims 55 to 63, further comprising:

collecting the unique information by using a terminal that can receive the unique information that the illumination device transmits; and

creating the illumination installation position information to be stored in a positioning system by associating the position at which the unique information is received and received unique information with each other.

[Claim 65] The positioning method according to any one of claims 53 to 64, further comprising

identifying, in the case where position detection processing can be switched between the positioning system and a second positioning system and where a terminal position information request is logical position information, the position of the terminal by using the unique information that the illumination device transmits.

[Claim 66] The positioning method according to claim 65, wherein

a positioning method carries out by the second positioning system is a positioning method using a wireless LAN.

[Claim 67] The positioning method according to claim 65 or claim 66, further comprising

identifying, in the case where the position of the terminal could not be identified by using the unique information, the position of the terminal by using the second positioning system.

[Claim 68] The positioning method according to claim 65 or claim 66, further comprising

determining whether to identify the position of the terminal using the unique information or using the second positioning system based on the type of the requested position information.

[Claim 69] A program for a positioning server in a positioning system for detecting a position of a terminal which receives unique information transmitted by an illumination device,

the program allowing the positioning server to function as position estimation means configured to estimate the position of the terminal based on the unique information that the terminal has received.

[Claim 70] The program according to claim 69, wherein

the position estimation means is configured to:

read out, from illumination installation position information in which the unique information and position information indicating the installation position of the illumination device are associated with each other, the position information corresponding to the unique information based on the unique information received by the terminal; and

estimate the position of the terminal based on the read out position information.

[Claim 71] A program for an application server in a positioning system for detecting a position of a terminal which receives unique information transmitted by n illumination device,

the program allowing a computer serving as the application server to function as display means configured to display the position information of the detected terminal.

[Claim 72] The program according to claim 71, wherein

the display means is configured to switch a display method of position information depending on the accuracy of acquired terminal position information.

[Claim 73] The program according to claim 71 or claim 72, wherein

the display means is configured to:

store attribute information concerning the terminal; and

display the position information of the terminal corresponding to specified attribute information.

[Claim 74] The program according to any one of claims 71 to 73, wherein

the display means is configured to display the terminal position information corresponding to a specified display condition.

[Claim 75] The program according to any one of claims 71 to 73, wherein

the program further allows the computer serving as the application server to function as acquisition means configured to:

receive a position information request concerning a terminal user;

identify the terminal that the user uses; and

acquire the position information of the identified terminal.

[Claim 76] The program according to claim 75, wherein

the acquisition means is configured to, in the case where a plurality of the user terminals exist, select one terminal in order of priority set for the respective terminals to acquire the position information thereof.

[Claim 77] The program according to claim 76, wherein

the acquisition means is configured to determine the priority based on the type of the terminal.

[Claim 78] The program according to claim 76, wherein

the acquisition means is configured to determine the priority such that the position information of the terminal using a wireless LAN has a higher priority.

[Claim 79] The program according to claim 76, wherein

the acquisition means is configured to determine the priority based on presence/absence of a response from the terminal.

[Claim 80] The program according to claim 76, wherein

the acquisition unit is configured to determine the priority based on the use state of the terminal.

[Name of Document] DESCRIPTION

[Title of Invention] DESCRIPTION POSITIONING SYSTEM, POSITIONING METHOD, AND PROGRAM THEREOF

[Title of Invention]

[Technical Field]

[0001]

The present invention relates to a positioning technique for identifying the position of a wireless terminal and, more particularly, to a positioning technique for identifying the position of an indoor wireless terminal.

[Background Art]

[0002]

In a cellular system, a positioning technique for identifying the position of a terminal using a signal from a plurality of GPS satellites or a plurality of base stations has been used. This technique can identify the position of a terminal with an accuracy of about 10 to 100 m.

[0003]

However, in an indoor environment, it is difficult to receive a signal from GPS satellites or base stations needed for position identification, preventing highly accurate identification of the terminal position.

[0004]

As a technique for identifying the position of a terminal used in an indoor environment, there are known positioning techniques such as one using a signal of a wireless LAN installed by and used at companies, shops or the like, one using a Bluetooth or RFID (Radio Frequency Identification) system.

[0005]

In order to perform accurate positioning using a wireless LAN, three or more wireless LAN base stations need to be seen by a positioning target terminal. However, in the wireless LAN, where base stations are not installed under the design of providers unlike the case of a cellular system but are often installed at irresponsible locations, there is no guarantee that the positioning target terminal can see three or more base stations. In a positioning system using a weak radio wave, such as a Bluetooth or RFID system, it is possible to achieve pinpoint positioning while it is necessary to install a large number of communication modules conforming to Bluetooth or RFID to walls and a ceiling, increasing installation cost.

[0006]

It can be seen, from such a background, it is not practical to install a positioning infrastructure that utilizes a Bluetooth or RFID system only for the positioning operation and, currently, a positioning technique capable of utilizing an infrastructure installed for purposes other than the positioning is required.

[Disclosure of Invention]

[Technical Problem]

[0007]

A first problem is that service coverage where a wireless LAN is used to achieve highly accurate positioning is low. The reason for this is that the area within which a positioning target terminal can see three or more wireless LAN base stations becomes narrower in highly accurate positioning system.

[0008]

A second problem is that installation cost of an infrastructure using a Bluetooth or RFID system is high. The reason is that securing of power supply, installation of a backbone communication infrastructure, and work for fixing a large number of communication modules conforming to Bluetooth or RFID to walls, a ceiling and the like are necessary in order to install the Bluetooth or RFID system as a positioning infrastructure.

[0009]

An object of the present invention is therefore to provide a technique to realize a positioning system for identifying the position of an indoor-use terminal at low cost.

[Solution to Problem]

[0010]

According to the first invention to solve the above problem, there is provided a positioning system for detecting the position of a terminal, comprising: a terminal configured to receive a unique information transmitted from an illumination device whose potation is given; and position estimation means configured to estimate the position of the terminal based on the unique information received by the terminal.

[0011]

According to the second invention to solve the above problem, in the first invention, the unique information is illumination identification information for uniquely identifying the illumination device.

[0012]

According to the third invention to solve the above problem, in the first or second invention,

the position estimation means is configured to: manage illumination installation position information including the unique information and position information indicating the installation position of the illumination device in association with each other; read out from the illumination installation position information the position information corresponding to the unique information that the terminal has received; and estimate the position of the terminal based on the read out position information.

[0013]

According to the fourth invention to solve the above problem, in any one of the first to third inventions, the illumination device comprises a light emission unit for emitting an illumination light and a transmission unit for transmitting the unique information.

[0014]

According to the fifth invention to solve the above problem, in the fourth invention, the transmission unit transmits the unique information on a visible light signal using a white LED.

[0015]

According to the sixth invention to solve the above problem, in the fourth invention, the transmission unit transmits the unique information on an infrared ray signal using an infrared LED.

[0016]

According to the seventh invention to solve the above problem, in the fourth invention, the transmission unit transmits the unique information on a radio signal using a wireless communication unit.

[0017]

According to the eighth invention to solve the above problem, in any one of the fourth to seventh inventions, the transmission unit transmits the unique information to the terminal at random timing.

[0018]

According to the ninth invention to solve the above problem, in any one of the fourth to eighth inventions, each of the light emission unit and transmission unit is configured to be separatable from a power source unit of the illumination device.

[0019]

According to the tenth invention to solve the above problem, in the ninth invention, each of the light emission unit and transmission unit is connected to the power source unit using a power source interface of a fluorescent tube for a fluorescent illumination device.

[0020]

According to the eleventh invention to solve the above problem, in the tenth invention, each of the light emission unit and transmission unit incorporates a power conversion unit.

[0021]

According to the twelfth invention to solve the above problem, in the eleventh invention, the power conversion unit is configured to convert an AC power supplied from the power source interface of a fluorescent tube into a DC power used by the light emission unit and transmission unit.

[0022]

According to the thirteenth invention to solve the above problem, in the tenth invention, the light emission unit uses a fluorescent tube, and the transmission unit incorporates the power conversion unit.

[0023]

According to the fourteenth invention to solve the above problem, in the thirteenth invention, the power conversion unit is configured to convert an AC power supplied from the power source interface of a fluorescent tube into a DC power used by the transmission unit.

[0024]

According to the fifteenth invention to solve the above problem, in the thirteenth invention, the power conversion unit comprises an overcurrent protection circuit for protecting the power source unit of the fluorescent illumination device.

[0025]

According to the sixteenth invention to solve the above problem, in the thirteenth invention, the power conversion unit comprises a power holding circuit for holding a power required for transmission of the unique information.

[0026]

According to the seventeenth invention to solve the above problem, in the thirteenth invention, two electrode terminals, which are the power source interface of a fluorescent tube, formed at one side of the fluorescent tube and power input terminals, which are connected to the power conversion unit for supplying a power to the transmission unit, are electrically connected in parallel to each other.

[0027]

According to the eighteenth invention to solve the above problem, in the seventeenth invention, the fluorescent tube is a straight fluorescent tube having two electrode terminals respectively on both sides thereof; the straight fluorescent tube further comprises a power acquisition unit which is connected in parallel to the two electrode terminals formed at one side

thereof and acquires a power to be supplied to the power conversion unit; and the power acquisition unit is formed into a plate having two holes through which the two electrode terminals are inserted.

[0028]

According to the nineteenth invention to solve the above problem, in the eighteenth invention, the power acquisition unit has a thickness of 1.3 mm or less.

[0029]

According to the twentieth invention to solve the above problem, in the ninth invention, each of the light emission unit and transmission unit is connected to the power conversion unit using a power source interface of an incandescent light bulb for an incandescent light bulb illumination device.

[0030]

According to the twenty-first invention to solve the above problem, in the twentieth invention, the light emission unit and transmission unit incorporate a power conversion unit.

[0031]

According to the twenty-second invention to solve the above problem, in the twenty-first invention, the power conversion unit is configured to convert a DC power voltage supplied from the power source interface of an incandescent light bulb into a voltage form that the light emission unit and transmission unit use.

[0032]

According to the twenty-third invention to solve the above problem, in any one of the fourth to eighth inventions, the illumination device comprises a solar battery unit; and the transmission unit is configured to transmit the unique information by using a power supplied from the solar battery unit.

[0033]

According to the twenty-fourth invention to solve the above problem, in the twenty-third invention, the solar battery unit is configured to convert a light energy output from the light emission unit into an electrical power.

[0034]

According to the twenty-fifth invention to solve the above problem, in the twenty-third invention, the illumination device comprises a rechargeable battery for storing a power supplied from the solar battery unit; and the transmission unit is configured to transmit the unique information when a power required for the transmission of the information has been stored in the rechargeable battery.

[0035]

According to the twenty-sixth invention to solve the above problem, in any one of the fourth to twenty-seventh inventions, the transmission unit is configured to determine an angle at which the unique information is transmitted depending on the size of the area within which the unique information can be received and installation level of the illumination device.

[0036]

According to the twenty-seventh invention to solve the above problem, in the twenty-sixth invention, the transmission unit comprises a plurality of LEDs for emitting a light signal, the LEDs being configured to transmit the unique information on the light signal in different directions.

[0037]

According to the twenty-eighth invention to solve the above problem, in the twenty-seventh invention, the transmission unit is configured to determine the number of LEDs that transmit the unique information depending on a difference in the transmission direction between the adjacent two LEDs, transmission angles of LEDs, size of the area within which the unique information can be received, and installation level of the illumination device.

[0038]

According to the twenty-ninth invention to solve the above problem, in any one of the first to twenty-eighth invention, the illumination device is configured to emit a light having a color indicating that it is transmitting the unique information.

[0039]

According to the thirtieth invention to solve the above problem, in any one of the first to twenty-eighth inventions, the illumination device is configured to emit a light using different colors for each service type.

[0040]

According to the thirty-first invention to solve the above problem, in any one of the first to twenty-eighth inventions, the illumination device is configured to emit a light using different colors for each service provider providing a service using the position information of the terminal.

[0041]

According to the thirty-second invention to solve the above problem, in the thirtieth or thirty-first inventions, the illumination device is configured to illuminate the area within which the terminal can receive the unique information with an illumination light.

[0042]

According to the thirty-third invention to solve the above problem, in any one of the first to

thirty-second inventions, the illumination device comprises a storage unit for storing the unique information.

[0043]

According to the thirty-fourth invention to solve the above problem, in any one of the third to thirty-third inventions, the illumination installation position information is configured to be created by associating the unique information collected by the terminal and installation position of the illumination device with each other.

[0044]

According to the thirty-fifth invention to solve the above problem, in any one of the first to thirty-fourth inventions, the positioning system further comprises a second positioning system; and the positioning system and second positioning system can be operated in a switchable manner.

[0045]

According to the thirty-sixth invention to solve the above problem, in any one of the first to thirty-fifth inventions, the second positioning system is a positioning system using a wireless LAN.

[0046]

According to the thirty-seventh invention to solve the above problem, in the thirty-fifth or thirty-sixth inventions, the positioning system is configured to identify the position of the terminal by using the unique information that the illumination device transmits, in the case where requested terminal position information is logical position information.

[0047]

According to the thirty-eighth invention to solve the above problem, in the thirty-fifth or thirty-sixth inventions, the positioning system is configured to identify the position of the terminal by using the second positioning system, in the case where the positioning system could not identify the position of the terminal by using the unique information.

[0048]

According to the thirty-ninth invention to solve the above problem, in the thirty-fifth or thirty-sixth inventions, the positioning system is configured to determine whether to identify the position of the terminal by using the unique information or by using the second positioning system, based on the type of the requested terminal position information.

[0049]

According to the fortieth invention to solve the above problem, in any one of the first to thirty-ninth inventions, the positioning system is configured to display acquired terminal position information.

[0050]

According to the forty-first invention to solve the above problem, in the fortieth invention, the positioning system is configured to switch a display method of position information depending on the accuracy of acquired terminal position information.

[0051]

According to the forty-second invention to solve the above problem, in the fortieth or forty-first inventions, the positioning system has a function of storing attribute information concerning the terminal and of displaying the position information of the terminal corresponding to specified attribute information.

[0052]

According to the forty-third invention to solve the above problem, in the forty-second invention, the positioning system is configured to store, as the attribute information of the terminal, a name of a department to which a terminal user belongs.

[0053]

According to the forty-fourth invention to solve the above problem, in any one of the fortieth to forty-third inventions, the positioning system is configured to display the terminal position information corresponding to a specified display condition.

[0054]

According to the forty-fifth invention to solve the above problem, in the forty-fourth invention, the positioning system is configured to specify, as the display condition, information of floors in which the terminal exists.

[0055]

According to the forty-sixth invention to solve the above problem, in any one of the first to forty-fifth inventions, the illumination device comprises a rechargeable battery and is configured to transmit information by using a power supply from the rechargeable battery in the case where it cannot use a power source thereof.

[0056]

According to the forty-seventh invention to solve the above problem, in any one of the first to forty-sixth inventions, the positioning system is configured to: identify a user terminal in response to a position information request concerning a user of the terminal; and acquire the position information of the identified terminal.

[0057]

According to the forty-eighth invention to solve the above problem, in any one of the first to

forty-seventh inventions, the positioning system is configured to select one terminal in order of priority set for the respective terminals to acquire the position information thereof, in the case where a plurality of the user terminals exist.

[0058]

According to the forty-ninth invention to solve the above problem, in any one of the first to forty-eighth inventions, the priority is configured to be determined based on the type of the terminal.

[0059]

According to the fiftieth invention to solve the above problem, in the forty-eighth invention, the priority is configured to be determined such that the position information of the terminal using a wireless LAN has a higher priority.

[0060]

According to the fifty-first invention to solve the above problem, in the forty-eighth invention, the priority is configured to be determined based on presence/absence of a response from the terminal.

[0061]

According to the fifty-second invention to solve the above problem, in the forty-eighth invention, the priority is configured to determined based on the use state of the terminal.

[0062]

According to the fifty-third invention to solve the above problem, there is provided a positioning method of a positioning system for detecting the position of a terminal, comprising: receiving, by a terminal, the unique information transmitted from an illumination device whose position is given; and estimating the position of the terminal based on the unique information received by the terminal.

[0063]

According to the fifty-fourth invention to solve the above problem, in the fifty-third invention, the unique information is illumination identification information for uniquely identifying the illumination device.

[0064]

According to the fifty-fifth invention to solve the above problem, in the fifty-third or fifty-fourth inventions, the positioning method further comprises: storing illumination installation position information including the unique information and position information indicating the installation position of the illumination device in association with each other; reading out the position information corresponding to the unique information from the stored illumination

installation position information based on the unique information received by the terminal; and estimating the position of the terminal based on the read out position information.

[0065]

According to the fifty-sixth invention to solve the above problem, in any one of the fifty-third to fifty-fifth inventions, a white LED is used as a light emission source of the illumination device and the unique information is transmitted by using a visible light signal emitted by the white LED.

[0066]

According to the fifty-seventh invention to solve the above problem, in any one of the fifty-third to fifty-fifth inventions, the unique information is transmitted by using an infrared ray signal emitted by an infrared LED.

[0067]

According to the fifty-eighth invention to solve the above problem, in any one of the fifty-third to fifty-fifth inventions, the unique information is transmitted by using a radio signal.

[0068]

According to the fifty-ninth invention to solve the above problem, in any one of the fifty-third to fifty-eighth inventions, the unique information is transmitted to the terminal at random timing by the illumination device.

[0069]

According to the sixtieth invention to solve the above problem, in any one of the fifty-third to fifty-ninth inventions, in the case where the light emission unit and transmission unit of the illumination device are connected to a power source unit by means of a power source interface of a fluorescent tube for a fluorescent illumination device, the light emission unit and transmission unit convert an AC power supplied from the power source interface of a fluorescent tube into a DC power.

[0070]

According to the sixty-first invention to solve the above problem, in any one of the fifty-third to fifty-ninth inventions, in the case where the light emission unit and transmission unit of the illumination device are connected to a power source unit by means of a power source interface of an incandescent light bulb for an incandescent light bulb illumination device, the light emission unit and transmission unit convert a DC power voltage supplied from the power source interface of an incandescent light bulb into a voltage form that they can use.

[0071]

According to the sixty-second invention to solve the above problem, in any one of the fifty-third to sixty-first inventions, the positioning method further comprises determining an angle at which the unique information is transmitted from the illumination device depending on the size of the area within which the unique information can be received and installation level of the illumination device.

[0072]

According to the sixty-third invention to solve the above problem, in any one of the fifty-third to sixty-second inventions, the positioning method further comprises determining, in the case where a plurality of LEDs are arranged in the illumination device so as to emit the unique information in different directions, the number of LEDs that transmit the unique information depending on a difference in the transmission direction between the adjacent two LEDs, transmission angles of LEDs, size of the area within which the unique information can be received, and installation level of the illumination device.

[0073]

According to the sixty-fourth invention to solve the above problem, in any one of the fifty-third to sixty-third inventions, the positioning method further comprises collecting the unique information by using a terminal that can receive the unique information that the illumination device transmits; and creating the illumination installation position information to be stored in a positioning system by associating the position at which the unique information is received and received unique information with each other.

[0074]

According to the sixty-fifth invention to solve the above problem, in any one of the fifty-third to sixty-fourth inventions, the positioning method further comprises identifying, in the case where position detection processing can be switched between the positioning system and a second positioning system and where a terminal position information request is logical position information, the position of the terminal by using the unique information that the illumination device transmits.

[0075]

According to the sixty-sixth invention to solve the above problem, in the sixty-fifth invention, a positioning method carries out by the second positioning system is a positioning method using a wireless LAN.

[0076]

According to the sixty-seventh invention to solve the above problem, in the sixty-fifth or sixty-sixth inventions, the positioning method further comprises identifying, in the case where the

position of the terminal could not be identified by using the unique information, the position of the terminal by using the second positioning system.

[0077]

According to the sixty-eighth invention to solve the above problem, in the sixty-fifth or sixty-sixth inventions, the positioning method further comprises determining whether to identify the position of the terminal using the unique information or using the second positioning system based on the type of the requested position information.

[0078]

According to the sixty-ninth invention to solve the above problem, there is provided a program for a positioning server in a positioning system for detecting a position of a terminal which receives unique information transmitted by an illumination device, the program allowing the positioning server to function as position estimation means configured to estimate the position of the terminal based on the unique information that the terminal has received.

[0079]

According to the seventieth invention to solve the above problem, in the sixty-ninth invention, the position estimation means is configured to: read out, from illumination installation position information in which the unique information and position information indicating the installation position of the illumination device are associated with each other, the position information corresponding to the unique information based on the unique information received by the terminal; and estimate the position of the terminal based on the read out position information.

[0080]

According to the seventy-first invention to solve the above problem, there is provided a program for an application server in a positioning system for detecting a position of a terminal which receives unique information transmitted by n illumination device, the program allowing a computer serving as the application server to function as display means configured to display the position information of the detected terminal.

[0081]

According to the seventy-second invention to solve the above problem, in the seventy-first invention, the display means is configured to switch a display method of position information depending on the accuracy of acquired terminal position information.

[0082]

According to the seventy-third invention to solve the above problem, in the seventy-first or seventy-second inventions, the display means is configured to: store attribute information

concerning the terminal; and display the position information of the terminal corresponding to specified attribute information.

[0083]

According to the seventy-fourth invention to solve the above problem, in any one of the seventy-first to seventy-third inventions, the display means is configured to display the terminal position information corresponding to a specified display condition.

[0084]

According to the seventy-fifth invention to solve the above problem, in any one of the seventy-first to seventy-third inventions, the program further allows the computer serving as the application server to function as acquisition means configured to: receive a position information request concerning a terminal user; identify the terminal that the user uses; and acquire the position information of the identified terminal.

[0085]

According to the seventy-sixth invention to solve the above problem, in the seventy-fifth invention, the acquisition means is configured to, in the case where a plurality of the user terminals exist, select one terminal in order of priority set for the respective terminals to acquire the position information thereof.

[0086]

According to the seventy-seventh invention to solve the above problem, in the seventy-sixth invention, the acquisition means is configured to determine the priority based on the type of the terminal.

[0087]

According to the seventy-eighth invention to solve the above problem, in the seventy-sixth invention, the acquisition means is configured to determine the priority such that the position information of the terminal using a wireless LAN has a higher priority.

[0088]

According to the seventy-ninth invention to solve the above problem, in the seventy-sixth invention, the acquisition means is configured to determine the priority based on presence/absence of a response from the terminal.

[0089]

According to the eightieth invention to solve the above problem, in the seventy-sixth invention, the acquisition unit is configured to determine the priority based on the use state of the terminal.

[Advantageous Effects of Invention]

[0090]

According to the present invention, the positioning infrastructure at a low cost can be realized, because the need to provide a power source for a positioning infrastructure is eliminated due to an illumination device having a function of transmitting unique information, and attachment to a ceiling is facilitated.

[Description of Embodiments]

[0091]

In the present invention, an illumination device transmits unique information, a terminal transmits the unique information of the illumination device to a position server, and then the position server identifies a position of the terminal by searching an illumination installation position database based on the unique information.

[First Embodiment]

[0092]

Embodiments of the present invention will be described in detail below with reference to the accompanying drawings.

[0093]

FIG. 1 is a view showing the entire configuration of a positioning system according to a first embodiment.

[0094]

The positioning system shown in FIG. 1 includes: a plurality of terminals 101 and 105 connected to light signal detection units 104 and 108; a plurality of base stations 102 and 106; a plurality of illumination devices 103 and 107 which transmit unique information as a light signal; one or more positioning servers 109; and one or more application servers 110. The positioning server and application server may be integrated as a single unit. Although not shown in FIG. 1, another network device or server unit may be used to constitute this system according to need.

[0095]

The detailed configuration of the above components will be described with reference to the drawings.

[0096]

FIG. 2 shows a configuration example of the illumination devices 103 and 107.

[0097]

The light illumination device includes: a power source unit 201; a unique information

storage unit 202 which retains and outputs unique information; a signal synthesis unit 203 which synthesizes an electrical power signal output from the power source unit 201 with the unique information output from the unique information storage unit 202; a transmission unit 204 which receives the electrical power signal with which the unique information has been synthesized and transmits the unique information as a light signal; a light emission unit 205 which emits a visible light as illumination; and other various required functions. The unique information may be number information for uniquely identifying the illumination devices or information indicating the position of the illumination device.

[0098]

The transmission unit 204 uses an infrared LED or a white LED. The transmission unit 204 may transmit a radio signal in place of the light signal. In this case, the transmission unit 204 functions as a transmission unit that transmits a radio signal. The unique information that the transmission unit 204 transmits may be identification information for uniquely identifying the illumination device or information indicating the position of the illumination device.

[0099]

The light emission unit 205 uses a white LED that emits the same white light as an ordinary illumination light. The light emission unit 205 may use an LED that emits a light having such a color that a user can visibly recognize that the illumination device includes the transmission unit 204.

[0100]

In the example of FIG. 2, the power source unit is shared by the transmission unit 204 and light emission unit 205. Alternatively, however, as shown in FIG. 32, the transmission unit 204 and light emission unit 205 may have power source units 3201 and 3202 respectively for individual use so as to be able to transmit the unique information even when the illumination device is turned off. Further, the illumination device may include a rechargeable battery. In this case, a power is supplied from the rechargeable battery to the transmission unit 204 during extinction. In the case where the transmission unit 204 uses a white LED, the light emission unit 205 can be omitted and, in this case, the transmission unit 204 uses the white LED to function also as the light emission unit 205. Further, as an illumination device actually used, the components excluding the power source unit 201, i.e., the light emission unit 205, unique information storage unit 202, signal synthesis unit 203, and transmission unit 204 may be configured to be detachable like an existing fluorescent tube or light bulb in fluorescent light illumination or filament lamp illumination. In this case, a plurality of light emission units 205 are configured as detachable units and one of the units may be configured as a transmission device constituted by the unique information storage unit 202, signal

synthesis unit 203, and transmission unit 204. Further, a configuration may be adopted in which the light emission unit 205, unique information storage unit 202, signal synthesis unit 203, and transmission unit 204 are formed as a unit having the same shape as that of an existing fluorescent tube or light bulb, a connection part of the unit to the power source unit is made equal to that of an existing fluorescent tube or light bulb, and the unit having such a configuration is attached to an existing illumination device. Specifically, the unit is made attachable to a socket conforming to JIS C 8302 (supporting IEC 60238) or JIS C 8324 (supporting IEC 60400).

[0101]

FIG. 19 shows another configuration of the illumination devices 103 and 107. In this configuration example, the unique information storage unit 202, signal synthesis unit 203, transmission unit 204, and light emission unit 205 are connected to a power source unit 1901 by means of a connection interface 1903.

[0102]

The power conversion unit 1902 converts a power received through the connection interface 1903 into a specification that the light emission unit 205 and the like can use. For example, in the case where the connection interface 1903 has the same specification as the interface of an existing fluorescent tube, a power to be supplied through the connection interface 1903 is an AC power. While in the case where the light emission unit 205 uses a white LED, it uses a DC power, so that the power conversion unit 1902 converts an AC power into a DC power. In the case where the connection interface 1903 has the same specification as the interface of an existing light bulb, a power to be supplied through the connection interface 1903 is a DC power of about 100V. While the light emission unit 205 and transmission unit 204 use a DC power at a lower voltage, so that the power conversion unit 1902 performs voltage conversion of the DC power.

[0103]

FIG. 34 shows still another configuration example of the illumination device 103 and 107.

In this configuration example, the unique information storage unit 202, signal synthesis unit 203, transmission unit 204, light emission unit 205, and power conversion unit 1902 are connected to the power source unit 1901 by means of the connection interface 1903. A power to be supplied through the connection interface 1903 is directly supplied to the light emission unit 205. While a power to be supplied to the unique information storage unit 202, signal synthesis unit 203, and transmission unit 204 is converted into a specification that the light emitting unit 205 and the like can use by the power conversion unit 1902. For example, in the case where the connection interface 1903 has the same specification as the interface of an existing fluorescent tube, a power to

be supplied through the connection interface 1903 is an AC power. While in the case where the transmission unit 204 uses an LED, it uses a DC power, so that the power conversion unit 1902 converts an AC power into a DC power.

[0104]

FIGS. 35 and 36 are views for explaining in more detail the configuration of the illumination device shown in FIG. 34.

Assume that a fluorescent tube is used as the light emission unit 205 of FIG. 34 in the present invention. Although there are lots of different types of fluorescent tubes, a straight fluorescent tube 3501 shown in FIG. 35 is used as the light emission unit 205.

[0105]

As shown in FIG. 35, two electrode terminals are formed respectively at both ends of the straight fluorescent tube 3501. Specifically, electrode terminals 3502 and 3503 are formed at one end of the straight fluorescent tube 3501 and electrode terminals 3504 and 3505 are at the other end thereof. Such a straight fluorescent tube 3501 is connected to a stabilizer 3601 through connectors 3603 and 3604, as shown in FIG .36. The stabilizer 3601 receives a power supply from an external power source and generates a voltage required for allowing the fluorescent tube 3501 to emit a light.

[0106]

FIG. 37 is a view showing an internal configuration of the straight fluorescent tube 3501. As shown in FIG. 37, electrode terminals 3502, 3503, 3504, and 3505 of the straight fluorescent tube 3501 are connected respectively to coil filaments 3701 and 3702 in the interior of the straight fluorescent tube 3501.

[0107]

Lighting operation of the straight fluorescent tube 3501 will be described. Firstly the stabilizer 3601 applies a residual heat voltage between the electrode terminals 3502 and 3503 and between the electrode terminals 3504 and 3505 to heat coil filaments 3701 and 3702 in the interior of the fluorescent tube. After a given time has elapsed, a high-voltage is applied between the electrode terminals 3502 on one side and 3503 and between the electrode terminals 3504 and 3505 on the opposite side to induce discharge between the electrodes at both ends of the straight fluorescent tube 3501 to light the fluorescent tube. The stabilizer continues applying a residual heat voltage between the electrode terminals 3502 and 3503 and between the electrode terminals 3504 and 3505 after the lightening of the straight fluorescent tube 3501.

[0108]

In the present embodiment, a residual heat voltage applied between the electrode terminals

3502 and 3503 and between the electrode terminals 3504 and 3505 is used to activate the unique information storage unit 202, signal synthesis unit 203, and transmission unit 204 to transmit unique information as a light signal.

[0109]

FIG. 38 shows a configuration of a power acquisition unit for acquiring a power used to activate the transmission unit 204 and the like from the connection portion between the straight fluorescent tube 3501 and stabilizer 3601. The power acquisition unit is a plate-like insulating body 3801 having two electrode insertion portions 3802 and 3803 serving as holes for inserting the electrode terminals 3502 and 3503 of the straight fluorescent tube 3501. The edges of the holes are formed as metal portions, which are brought into contact with the electrode terminals 3502 and 3503 respectively to establish electrical connection between the electrode insertion portion 3802 and electrode terminal 3502 and between the electrode insertion portion 3803 and electrode terminal 3503.

Power source lines 3804 and 3805 are connected to the electrode insertion portions 3802 and 3803 to connect the power conversion unit 1902 and electrode insertion portions 3802, 3803.

[0110]

FIG. 39 shows a state where the power acquisition unit shown in FIG. 38 is attached to the straight fluorescent tube 3501. Although the insulating body 3801 is inserted all the way when actually used, FIG. 39 shows a state where the insulating body 3801 has been inserted halfway so as to make attachment state understandable. A use of such power acquisition unit allows attachment of the transmission unit and the like in electrically parallel to the coil filament 3701 and the like to thereby allow the transmission unit 204 and the like to use a part of residual heat power.

[0111]

Although the power acquisition unit is formed into a disk shape in FIGS. 38 and 39, it may be formed into any other shapes. When the diameter of the power acquisition unit, excluding the power source lines 3804 and 3805, is made smaller than the diameter of the fluorescent tube 3501, it becomes easier to attach the power acquisition unit to various types of fluorescent devices. The diameter of the fluorescent tube is specified by JIS C 7601.

[0112]

It is preferable that the thickness of the insulating body 3801 be set to 1 mm or less. For example, JIS C 7601 specifies that the standard length of the main body of a starter-type 40-straight fluorescent tube is 1198.0 mm (maximum value: 1199.4 mm). Many fluorescent tube manufacturers manufacture fluorescent tubes according to the above standard length. Accordingly,

the 40-straight fluorescent tube has a margin of 1.4 mm in specification. Thus, when the thickness of the insulating body 3801 is set to 1.4 mm or less, it is possible to allow the total length obtained by combining the length of the fluorescent tube and insulating body 3801 to fall within the specification of JIS C 7601, allowing attachment of the insulating body 3801 without modification of an existing fluorescent illumination devices. There is a margin of 1.3 to 1.4 mm between standard and maximum values in starter-type straight fluorescent of other sizes, rapid start type straight fluorescent tubes, and high frequency lighting type straight fluorescent tubes according to JIS C 7601. Thus, when the thickness of the insulating body 3801 is set to about 1 mm or less, the insulating body 3801 can correspond to various fluorescent tubes.

[0113]

Although the hole-shaped electrode insertion portions 3802 and 3803 are used to connect the electrode terminals 3502 and 3503 in FIGS. 38 and 39, the electrode insertion portions may be formed into any shape as long as they can connect the power source lines 3804, 3805 and electrode terminals 3502, 3503 to establish electrical connection between them respectively so as to provide a power to the power acquisition unit.

[0114]

FIG. 40 shows a detailed configuration example of the power conversion unit 1902 to be connected to the fluorescent tube circuit shown in FIG. 36.

[0115]

The residual heat power of the fluorescent tube that can be acquired using the power acquisition unit as shown in FIG. 38 is an AC power. Thus, a rectifying circuit 4001 is used to rectify the AC power into a DC power. Then, a smoothing circuit 4002 is used to smooth the rectified power waveform. After that, the power whose waveform has been smoothed is passed through a voltage conversion circuit 4003, where the power is converted into a voltage required for the transmission unit 2004 and the like. Then, the power is passed though an overcurrent protection circuit 4004 which restricts acquisition of an excess power in order to protect the stabilizer 3601 and stored in a power holding circuit 4005.

[0116]

A current restricting resistor or a fuse may be used as the overcurrent protection circuit 4004. It is possible to dispose the overcurrent protection circuit 4004 not only at the position shown in FIG. 40, but also between the smoothing circuit 4002 and voltage conversion circuit 4003.

[0117]

A capacitor or a secondary battery may be used as the power holding circuit 4005. The

power holding circuit 4005 is a circuit for the transmission unit to store a power required for transmitting unique information while it does not perform the transmission of the unique information. Therefore, the power holding capability of the power holding circuit 4005 is determined based on a power required for transmission of the unique information and transmission interval of the unique information.

[0118]

FIG. 41 shows another configuration of the fluorescent tube 3501 and connector 3603 connected to the illumination device shown in FIG. 36. In FIG. 41, power lines 4101 and 4102 for power acquisition are connected respectively to the electrode terminals 3502 and 3503 in the interior of the straight fluorescent tube 3501.

[0119]

Although the straight type fluorescent tube is used in FIGS. 35 to 41, fluorescent tubes having other shapes, such as circular tube, may allow a residual heat power to be utilized for the transmission of the unique information on the same principle as above.

[0120]

FIG. 3 shows a configuration example of the light signal detection units 104 and 108. Each of the light signal detection units 104 and 108 includes a reception unit 301 for receiving a light signal transmitted from each of the illumination devices 103 and 107, a received signal processing unit 302 for extracting unique information of the respective illumination devices from the received light signal, a host interface unit 303 for transferring the extracted unique information to the terminal, and other required functions. In the case where a radio signal is used as a transmission signal, the reception unit 301 serves as a reception unit for receiving a radio signal.

[0121]

FIG. 4 shows a configuration example of the terminals 101 and 105. The terminal includes a unique information reception unit 401 for receiving the unique information notified from the light signal detection unit 104 or 108, a unique information storage unit 402 for storing the notified unique information, a server interface unit 403 for notifying the positioning server 110 of the unique information, and other required functions. FIG. 4 only shows a part of the terminal related to the present embodiment.

[0122]

FIG. 5 shows a configuration example of the positioning server 109. The positioning server 109 includes an application interface unit 501 for performing communication with the application server 110, a terminal controller 502 for performing communication with the terminal,

an illumination installation position database 503 for storing illumination installation position information in which unique information of the respective illumination devices and installation positions thereof are associated with each other, a terminal information storage unit 504 for storing terminal information in which the terminal ID of the each terminal and unique information that each terminal has received are associated with each other; a position detection processing unit 505 for detecting the position information of the terminal based on information of the illumination installation position database 503 and terminal information storage unit 504; and other required functions.

[0123]

FIG. 6 shows a configuration example of the transmission unit 204 and light emission unit 205. In the example shown in FIG. 6, white LEDs 601, 602, and the like constituting the light emission unit 205, transmission LEDs 603, 604, and the like which constitute the transmission unit 204 and transmit a signal such as a red LED or a white LED are arranged in a plane. In the transmission unit 204 and light emission unit 205, LEDs may be arranged in a half cylinder shape or in a hemisphere. The white LEDs may be used as the transmission unit 204 and the light emission unit 205 and the transmission unit 204 may be commonly used. In this case, all LEDs shown in FIG. 6 are used both as the transmission unit and light emission unit.

[0124]

FIG. 20 shows a configuration example of the illumination device shown in FIG. 19, excluding the power source unit 1901. In the example of FIG. 20, an interface of an existing fluorescent tube is used as the connection interface 1903 shown in FIG. 19.

[0125]

An illumination module 2001 is attached to an existing fluorescent illumination device using connection interfaces 2002 to 2005 and receives a power using the same. The power supplied through the connection interfaces 2002 to 2005 is input to a power conversion unit 2008 where the power conversion is performed. The power conversion unit 2008 performs AC-DC conversion for the input power and supplies it to a transmission unit 2007 and light emission unit 2006. In FIG. 20, wirings for connecting the connection interfaces 2002 to 2005 and power conversion unit 2008 are omitted. Further, in FIG. 20, the unique information storage unit 202 and signal synthesis unit 203, which are shown in FIG. 19, are omitted.

[0126]

FIG. 32 shows another example of the illumination devices 102 and 106. FIG. 33 is an example of the illumination device shown in FIG. 32 in which the power source unit is divided in

two segments. In FIG. 33, the illumination device, which is installed to a ceiling or the like, is viewed from the side, and the unique information storage unit 202 and signal synthesis unit 203, which are shown in FIG. 32, are omitted.

In this example, light emission units 3302 and 3303 receive a power from a power source unit 3301 and emit light.

A transmission unit 3305 transmits unique information using a power supplied from a solar battery unit 3304.

The solar battery unit 3304 converts a light energy that the light emission units 3302 and 3303 into an electrical energy and supplies the electrical energy to the transmission unit 3305.

The solar battery unit 3304 and transmission unit 3305 are attached to a lighting cover 3306 by means of attachment portions 3307 and 3308.

In the case where the lighting cover 3306 is made of steel, magnets may be used as the attachment portions 3307 and 3308.

In the configuration shown in FIG. 33, a rechargeable battery may be incorporated in the solar battery unit 3304. In this case, an output of the rechargeable battery is used to allow the transmission unit 3305 to transmit unique information. If an electrical energy that has been converted from a light energy in the solar battery unit 3304 is insufficient for driving the transmission unit 3305 and the like, unique information is allowed to be transmitted after a sufficient electrical energy has been stored in the rechargeable battery.

[0127]

FIG. 7 shows a configuration of the transmission LED 603 and 604 shown in FIG. 6. Since the direction of light emitted from the LED is limited in general, the direction of a signal transmitted from the transmission LED is also limited. In FIG. 7, the angle at which a transmission LED 701 can transmit a signal is represented by θ_1.

[0128]

FIG. 8 shows an example in which the transmission unit 204 shown in FIG. 2 is constituted by a plurality of transmission LEDs. In the configuration example shown in FIG. 8, transmission LEDs including LEDs 801, 802, and the like are arranged at an angle of θ_2 relative to one another for widening the transmission direction of a signal from the transmission unit 204. Although the θ_2 is generally set to a value equal to θ_1, it may be set to any value depending on usage. Although the LEDs are three-dimensionally arranged so as to control the transmission direction in

FIG. 8, a configuration using a lens or LEDs having different light emission angles from the angle θ_1 to control the transmission direction may be adopted.

[0129]

FIG. 9 shows a state where a transmission unit 901 transmits unique information to a transmission area 902. In the example of FIG. 9, the diameter of the transmission area 902 is x(m) and the vertical distance from the transmission area 902 to illumination device 901 is y(m).

[0130]

FIG. 13 is a table showing a configuration example of terminal information that the terminal information storage unit 504 shown in FIG. 5 stores. The terminal information associates terminal ID 1301 for uniquely identifying respective terminals with unique information 1302 of the illumination devices received by the respective terminals. In the terminal information, a plurality of unique information may be associated with one terminal ID. Further, reception time 1303 indicating the time at which the unique information 1302 is received may be stored as the terminal information. Further, in the case where reception time 1303 is stored in the configuration in which a plurality of unique information are associated with one terminal ID, reception time 1303 may be stored for each individual unique information.

[0131]

FIG. 14 is a table showing a configuration example of illumination installation position information that the illumination installation position database 503 stores. The illumination installation position database 503 stores unique information 1401 that the individual illumination devices transmit and the position information of the positions at which the illumination devices are installed in association with each other. The position information includes logical information 1402 such as a name or number of the room at which the illumination device is installed, coordinate information 1403 indicating the installation position of the illumination device on a design drawing of a building or the like, area information 1404 indicating the size of the area at which the illumination device transmits a signal, and the like.

[0132]

Hereinafter, the operation of the present invention will be described.

[0133]

FIG. 10 is a time chart showing signal exchanged between devices in the present invention. Although a plurality of illumination devices, light signal detection units, terminals, and base stations are actually provided in this embodiment, the following description will be given using the

illumination device 103, light signal detection unit 104, terminal 104, and base station 102.

[0134]

The illumination device 103 notifies unique information (ID information) of each illumination device on a light signal. Instead of the light signal, a radio signal may be used for notification of the unique information. The notification of the unique information from the illumination device may be continuously repeated or periodically repeated. In this embodiment, the notification is periodically repeated (steps 1001 and 1002). In the case where the notification is periodically repeated, illumination devices perform notification at random frequencies or at frequencies unique to the respective illumination devices so as to prevent collision of the unique information issued from respective illumination devices. As the light signal carrying the unique information, an infrared light signal produced by an infrared LED or the like or a visible light signal produced by a white LED or the like may be used.

[0135]

After receiving a light signal periodically notified from the illumination device 103 and extracting unique information from the light signal, the light signal detection unit 104 or 106 transfers the extracted unique information to the terminal 101 (steps 1003 and 1004). In the case of receiving light signals from a plurality of illumination devices and extracting a plurality of unique information, the light signal detection unit 104 may transfer the plurality of unique information to the terminal 101. In this case, a received light intensity measurement unit is provided in the light signal detection unit 104, and the light signal detection unit 104 transfers received light intensity information from the respective illumination devices together with the unique information. In this case, the light signal detection unit 104 may transfer only the unique information of the illumination device whose light receiving intensity is highest. Further, the notification of the unique information from the light signal detection unit 104 to terminal 101 may be performed periodically, based on a request from the terminal, or every time the light signal detection unit 104 detects the unique information notified from the illumination device 103.

[0136]

The terminal 101 that has received the unique information notified from the illumination device 103 transmits the acquired unique information to the positioning server 109 through the base station 102 (steps 1005, 1006, 1007, and 1008). A wireless LAN and the like may be used for communication between the terminal 101 and base station 102. The notification of the unique information from the terminal 101 to the positioning server 109 may be performed periodically or based on a request from the positioning server 109. The positioning server 109 stores the unique

information notified from respective terminals together with the identification information of respective terminals. Examples of the identification information of respective terminals include an IP address, MAC address, and a name of a user who uses the terminal.

[0137]

Upon receiving a request for the position information of a specified terminal from the application server 110 (step 1009), the positioning server 109 searches for the unique information of the illumination device stored in association with the identification information of the required terminal and converts the found unique information into position information such as a number of a room at which the illumination device is installed (step 1010).

[0138]

Then, the positioning server 109 transmits the position information to the application server 110 as a replay (step 1011). As the position information to be transmitted to the application server 110, coordinate information indicating the position inside a building at which the illumination device is installed may be transmitted, or the unique information of the illumination device may be transmitted without modification. Although the notification of the position information to the application server 110 is performed based on a request from the application server 110 in the above example, it may be performed periodically or at the timing when the unique information of the illumination device 103 that the terminal has already received is changed.

[0139]

Next, the operation of the illumination devices 103 or 107 will be described using FIGS. 1, 2, and 11.

[0140]

The LED, which receives a power supply from the power source unit 201 and functions as the light emission unit 205, emits a visible light as an illumination light. Unique information output from the unique information storage unit 202 is added to a power to be supplied to the LED used as the transmission unit 204 by the signal synthesis unit 203. As a method of synthesizing the unique information with a power to be supplied to the LED, any method can be used in the present embodiment. For example, there is available a method of controlling ON/OFF of a power to be supplied to the transmission unit 204 based on the unique information which is represented as binary data of 0 and 1 as shown in FIG. 11. Further, as for the synthesis timing of the unique information, any method can be used in the present embodiment including a method of performing synthesis periodically or at random timings. In order to facilitate the detection of the unique information on the receiving side, preamble information including a specified pattern of 0 and 1 may be added to

the beginning of the unique information.

The transmission unit 204 uses a power that the signal synthesis unit 203 outputs to transmit a signal. In the case where the signal synthesis unit 203 is performing the ON/OFF control, the transmission unit 204 repeats blinking to perform notification of the unique information.

[0141]

Next, the operation of the light signal detection units 104 or 108 will be described using FIGS. 1 and 3.

[0142]

The reception unit 301 receives a light signal from the illumination device 103 and the like, converts the light signal into an electrical signal, and outputs the electrical signal corresponding to the intensity of the received light to the received signal processing unit 302.

[0143]

The received signal processing unit 302 extracts the unique information of the illumination device 103 and the like from the input electrical signal and outputs it to the host interface unit 303. Examples of the extraction method of the unique information include a method of detecting the preamble information added by the illumination device side and extracting the unique information following the preamble information, and the like.

[0144]

The host interface unit 303 outputs the extracted unique information to the terminal. The unique information may be output every time the host interface unit 303 extracts the unique information or based on a request from the terminal. In the present embodiment, the unique information may be output using either method.

[0145]

Next, the operation of the terminals 101 or 105 will be described using FIGS. 1 and 4.

[0146]

The unique information reception unit 401 receives the unique information transmitted from the light signal detection unit 104 and transmits it to the unique information storage unit 402. Further, the unique information reception unit 401 receives a request from the server interface unit 403 and, correspondingly, transmits a request for the light signal detection unit 104 to transmit the unique information.

[0147]

The unique information storage unit 402 stores the unique information transmitted from the unique information reception unit 401 and outputs the unique information to the server interface unit

403 in response to a request from the server interface unit 403.

[0148]

Next, the operation of the positioning server 109 will be described using FIGS. 1, 5, and 12.

[0149]

The application interface unit 501 of the positioning server 109 receives a request for the position of the terminal which is issued from an application of the application server 110 and the like (Yes in step 1201) and, correspondingly, requires the position detection processing unit 505 to transmit the position information of the terminal.

[0150]

The position detection processing unit 505 performs search processing to determine whether the terminal information storage unit 504 stores the unique information of the illumination device that has been received by the terminal whose position is requested (step 1202).

[0151]

If it is determined that the unique information has not been found, (No in step 1203), the position detection processing unit 505 transmits a unique information request message to the terminal through the terminal controller 502 (step 1204). Although a method of performing a search to determine whether the terminal information storage unit 504 stores the unique information is shown in the flowchart of FIG. 12, the search processing in step 1202 may be omitted. In this case, when receiving the terminal position request from the application, the position detection processing unit 505 inevitably proceeds to step 1204 where it transmits the unique information request message to the terminal.

The terminal controller 502 that has received the unique information from the terminal notifies the position detection processing unit 505 of the unique information as well as writes the unique information in the terminal information storage unit 504. At this time, reception time of the unique information may be written in the terminal information storage unit 504.

[0152]

Subsequently, the position detection processing unit 505 that has received the unique information from the terminal (YES in step 1205) uses the received unique information to search the illumination installation position database 503 for illumination installation position information (step 1206). If it is determined that the terminal information storage unit 504 stores the unique information that has previously received from the terminal and its reception time falls within a predetermined time measured from the current time (step 1203) as a result of the search processing of searching the unique information of the terminal whose position is requested from the terminal

information storage unit 504 in step 1202, the position detection processing unit 505 may skip the unique information request process for the terminal (steps 1204 and 1205) and proceed to step 1206, where it uses the unique information stored in the terminal information storage unit 504 to search the illumination installation position database 503. If it is determined that the terminal information storage unit 504 stores a plurality of unique information as a result of the search processing in step 1202, the position detection processing unit 505 may use respective unique information to search the illumination installation position database 503 or may use only unique information with the latest reception time to perform the search processing.

[0153]

If it is determined that the illumination installation position information corresponding to the unique information could be acquired as a result of the search processing in step 1206 (YES in step 1207), the position detection processing unit 505 transmits the illumination position information acquired form the illumination installation position database 503 to the application through the application interface unit 501 as a replay (step 1208).

[0154]

On the other hand, if it is determined that the unique information from the terminal could not be received in step 1205 (No in step 1205) or that illumination installation position information corresponding to the unique information could not be acquired as a result of search processing for the illumination installation position database 503 in step 1206 (No in step 1207), the position detection processing unit 505 transmits an error notification to the application as a replay through the application interface unit 501 (step 1209).

[0155]

Next, a method of controlling the transmission area of the unique information from the transmission unit 204 and the like will be described using FIGS. 1 and 7 to 9.

[0156]

Assuming that the diameter of the transmission area 902 is x(m) and vertical distance between the transmission area 902 and transmission unit 901 is y(m) as shown in FIG. 9, the transmission unit 901 needs to transmit a signal at an angle of θ_3 in order for the transmission signal to cover the entire transmission area 902. Assuming that the transmission angle of the LED 701 is θ_1 as shown in FIG. 7 and attachment angle (difference in transmission direction) between the LEDs 801 and 802 of the transmission unit 901 is θ_2 as shown in FIG. 8, the transmission

angle θ_3 of the transmission unit 901 can be represented by $\theta_2 \times n$ (n = the number of LEDs - 1) + θ_1. In the case the transmission unit 901 has the LED 801 facing directly downward and other two LEDs on both sides of the LED 801 as shown in FIG. 8, the transmission angle θ_3 can be represented by $\theta_2 \times 2 + \theta_1$ at maximum (n = 2).

In the case of using the LED 801 facing directly downward for signal transmission, the transmission angle isθ_1. In the case of using the LED 801 and LEDs 802, 804 on both sides of the LED 801, the transmission angle θ_3 is represented by $\theta_2 + \theta_1$. Although the required transmission angle θ_3 is changed depending on the size (x) of the transmission area and attachment level (y) of the transmission unit 901, the above change of the number of LEDs to be used for signal transmission allows the transmission angle θ_3 to be controlled. There is also available a method that uses LEDs having different transmission angles θ_1 or uses a lens or mirror to control the transmission angle θ_3.

[0157]

Next, an operation mode of the entire system (FIG. 1) according to the first embodiment will be described.

[0158]

As an example of the operation mode to which the present system is applied, it can be assumed that a plurality of the illumination devices 103 and 107 are provided in, e.g., each meeting room in an office building. The emission color of the illumination devices 103 and 107 may be differentiated from that of other illumination devices commonly used. By adopting a different color for the illumination devices 103 and 107, it is possible to explicitly inform a user of the installation position of the illumination device having a signal transmission function, allowing the user to know a location where he or she can receive a service using the position information of the terminal. Further, the use of a different color allows the user to visually grasp the area within which he or she can acquire the position information, so that it is possible for the user to easily know to which area he or she should move the terminal in order to acquire the position information. A different emission color may be used for each service provider providing a service using the position

information of the terminal, or may be used for each service type.

[0159]

A creation method of the illumination installation position database 503 shown in FIGS. 5 and 14 will be described.

[0160]

The simplest method of collecting the unique information that the illumination device transmits and information corresponding to the installation position of the illumination device is as follows: storing unique information for uniquely identifying the illumination device in the illumination device or the transmission unit attached to the illumination device; reading out the stored unique information at or after the installation time of the illumination device; and relating the unique information to the installation position of the illumination device that transmits the relevant unique information. Further, another method of creating the illumination installation position database 503 may be employed in which the installation location of the illumination device is investigated using a terminal provided with the light signal detection unit after the installation of the illumination device and a correspondence between the unique information that the terminal has received and location that has been investigated is stored.

[Second Embodiment]

[0161]

As an embodiment different from the above first embodiment, a configuration that allows a positioning system using a wireless LAN and positioning system using an illumination device to work together in a switchable manner will be described as a second embodiment. In this embodiment, the same reference numerals as the first embodiment are given to the components which are common to the first embodiment, and the overlapped description is omitted. Since the second embodiment is basically the same as the first embodiment, the description will be given focusing on the differences from the first embodiment.

[0162]

The second embodiment differs from the first embodiment in the internal configuration of the positioning server 109 shown in FIG. 1.

[0163]

FIG. 15 shows a configuration example of the positioning server 109 used in the case where a positioning system using a wireless LAN and positioning system using an illumination device are allowed to work together.

[0164]

The positioning server 109 includes an application interface unit 1501 for performing communication with the application server; a terminal/base station controller 1502 for performing communication with the terminal and base station; an illumination installation position database 1503 for storing illumination installation position information in which unique information of the respective illumination devices and installation positions thereof are associated with each other; a base station installation position database 1506 for storing base station installation position information in which the IDs of respective wireless LAN base stations and installation positions thereof are associated with each other; a terminal information storage unit 1504 for storing terminal information in which the ID of each terminal, unique information of the illumination device that the terminal has received, ID of the wireless LAN base station to which the terminal is connected are associated with each other; a position detection processing unit 1505 for detecting the position information of the terminal based on information of the illumination installation position database 1503, base station installation position database 1506, and terminal information storage unit 1504; and other required functions.

[0165]

FIG. 16 shows a configuration example of the terminal information that the terminal information storage unit 1504 of FIG. 15 stores.

[0166]

The terminal information storage unit 1504 shown in FIG. 16 stores ID 1601 of the base station to which the terminal is connected in addition to terminal ID 1301, unique information 1302 of the illumination device, and unique information reception time 1303. The terminal information storage unit 1504 may store time information 1602 indicating the time point at which the terminal is connected to the base station.

[0167]

FIG. 17 shows a configuration example of information that the base station installation position database 1506 of FIG. 15 stores.

[0168]

The base station installation position database 1506 stores ID information 1701 of each base station and position information of the location at which the base station is installed in association with each other. The position information includes logical information 1702 such as a name or number of the room at which the base station is installed and coordinate information 1703 indicating the installation position of the base station on a design drawing of a building or the like. The position information may further include area information 1704 indicating the size of the area within

which the terminal can be connected to the base station.

[0169]

A configuration in which the application server 110 displays seating positions will be described.

FIG. 22 shows a configuration example of the application server 110 according to the second embodiment. The application server 110 includes a display condition input unit 2201, a user information processing unit 2202, a user information management unit 2203, a terminal information management unit 2204, a positioning server interface unit 2205, a floor map management unit 2206, a user position display unit 2207, and other required functions.

[0170]

The display condition input unit 2201 receives an input of information concerning a terminal user to be displayed from a viewer of seating positions.

The user information processing unit 2202 collects information concerning display condition, user, terminal, and floor map and generates information used for display of seating positions based on the collected information.

The user information management unit 2203 manages information concerning the terminal that a user uses.

The terminal information management unit 2204 manages information such as a terminal position and a login account (user ID) used when the terminal accesses a wireless LAN.

The positioning server interface unit 2205 requests the terminal position from the positioning server.

The floor map management unit 2206 stores a floor map and manages registration and deletion of the floor map.

The user position display unit 2207 displays the position of the user to a viewer.

Although the display condition input unit 2201 and user position information display unit 2207 are incorporated in the application server 110 in the above configuration, they may be incorporated in a client machine that a viewer uses.

[0171]

FIG. 23 is a configuration example of the user information that the user information management unit 2203 stores.

The user information management unit 2203 stores a user ID for uniquely identifying a user in the system, a user name for display purpose, a department name which indicates the department to which the user belongs as the attribute information of the terminal, a list of terminals that the user

uses, a terminal type indicating whether the terminal is connected to a wireless LAN or wired LAN, and the like. The user name may include a term indicating duty positions such as "Department manager" or "Unital chief". The information stored as terminal list may include information capable of uniquely identifying the terminal, such as IP address or MAC address of the terminal, in addition to the terminal name. In the case where the terminal type indicates a terminal connected to the wired LAN, it may include the installation position of the terminal. Further, in addition to the department name, information representing the attribute of the user may be stored as the user information.

[0172]

FIG. 24 shows a configuration example of the terminal information that the terminal information management unit 2204 shown in FIG. 22 stores.

The terminal information management unit 2204 stores information such as terminal name, position information, position accuracy, and position acquisition time.

As the terminal name, information for uniquely identifying the terminal is stored. The information for uniquely identifying the terminal may include IP address or MAC address of the terminal. A plurality of such information for identifying the terminal may be registered for one terminal.

As the position information, a result of measurement of the terminal position is stored. In the example shown in FIG. 24, the position within a floor is represented by XY coordinates. "F=2, X=10, Y=30" means that the terminal is located in the second floor (F=2) and at the position 10 m apart from a reference point previously determined within a floor in X direction and 30 m apart therefrom in Y direction. As the part (F=2) indicating the floor information, a floor name or a file name of a floor map may be specified.

As the position accuracy, information indicating the accuracy of the terminal position information is stored. Although a position error within a floor is registered in units of meter in the example of FIG. 24, the information concerning the position accuracy is not limited to this. In place of the position accuracy information represented in units of meter, a value represented using a positioning technique for position information acquisition may be used. In this case, information such as "illumination positioning" "wireless LAN base station positioning" may be stored as the position accuracy information. As the position acquisition time, the time at which the position of the terminal is measured is stored.

[0173]

FIG. 25 shows a configuration example of the floor information that the floor map

management unit 2206 stores. The floor information includes floor name, file name of floor map, floor ID for uniquely identifying the floor, and area depicted on the floor map. For example, 4Fmap.jpg in the table of FIG. 25 targets fourth floor (floor ID F=4) and depicts the position starting from 20 m point apart from a predetermined reference point to 50 m point therefrom in X direction and position starting from 0 m point apart from the reference point to 40 m point therefrom in Y direction. FIG. 26 shows an example of the floor map stored as a file.

[0174]

Next, the operation of the positioning server 109 will be described using FIGS. 15 and 18.

[0175]

Steps 1201 to 1209 shown in FIG. 18 are the same as those shown in FIG. 12. Upon receiving a request for terminal position information from an application of the application server 110 or the like, the application interface unit 1501 of the positioning server 109 transmits a terminal position information request in which the type of the requested position information has been written to the position detection processing unit 1505 (YES in step 1201).

[0176]

Upon receiving the terminal position information request, the position detection processing unit 1505 determines the type of the requested position information and determines whether the requested position information is the logical position information such as room number (step 1801).

[0177]

If the requested position information is not the logical position information such as room number but coordinate information (NO in step 1801), the position detection processing unit 1505 performs terminal position identification processing using a wireless LAN (step 1802). For example, a wireless LAN signal is measured in the terminal or a plurality of base stations to detect the signal level or signal propagation time between the terminal and base stations and, based on the detection result, the position of the terminal is identified. During the terminal position identification processing using a Wireless LAN, the position detection processing unit 1505 searches the terminal information storage unit 1504 so as to acquire information concerning the base station to which the terminal is connected or searches the base station installation position database 1503 so as to acquire information of the installation position coordinate of wireless LAN base stations.

[0178]

If the terminal position identification processing using a wireless LAN has succeeded (YES in step 1803), the position detection processing unit 1505 transmits the terminal position information to the application through the application interface unit 1501 as a reply (step 1208).

[0179]

If the requested position information is the logical position information such as room name (YES in step 1801) or if the terminal position identification processing using a wireless LAN has failed (NO in step 1803), the position detection processing unit 1505 searches the terminal information storage unit 1504 to determine whether it stores the unique information that the requested terminal has received (step 1202) in the same manner as described in FIG. 12.

[0180]

If the terminal information storage unit 1504 does not store the unique information that the requested terminal has received (NO in step 1203), the position detection processing unit 1505 transmits a unique information request message to the terminal through the terminal controller 1502 (step 1204). The search processing of the terminal, in step 1202 may be omitted. In this case, when receiving the terminal position request from the application, the position detection processing unit 1505 inevitably proceeds to step 1204 where it transmits the unique information request message to the terminal. The terminal controller 1502 that has received the unique information from the terminal notifies the position detection processing unit 1505 of the unique information as well as writes the unique information in the terminal information storage unit 1504. At this time, reception time of the unique information may be written in the terminal information storage unit 1504.

[0181]

The position detection processing unit 1505 that has received the unique information from the terminal (YES in step 1205) uses the received unique information to search the illumination installation position database 1503 (step 1206). If it is determined that the terminal information storage unit 1504 stores the unique information that has previously received from the terminal and its reception time falls within a predetermined time measured from the current time (YES in step 1203) as a result of the search processing in step 1202, the position detection processing unit 1505 may skip the unique information request process for the terminal (steps 1204 and 1205) and use the unique information stored in the terminal information storage unit 1504 to search the illumination installation position database 1503 (step 1206 in FIG. 18).

[0182]

If it is determined that the illumination installation position information corresponding to the unique information is acquired as a result of the search processing for the illumination installation position database 1503 (YES in step 1207), the position detection processing unit 1505 transmits the illumination installation position information acquired form the illumination installation position

database 1503 to the application through the application interface unit 1501 as a replay (step 1208). If it is determined that the unique information from the terminal could not be received in step 1205 (No in step 1205) or that illumination installation position information corresponding to the unique information could not be acquired as a result of search processing for the illumination installation position database 1503 in step 1206 (No in step 1207), the position detection processing unit 1505 transmits an error notification to the application as a replay through the application interface unit 1501 (step 1209).

[0183]

As a method other than the above operation example, a method may be adopted in which a wireless LAN is used to perform terminal position identification processing in the case where the position identification processing using the unique information of the illumination device cannot be performed or has failed.

[0184]

An operation example of the application server 110 will be described using FIGS. 22 to 27.

[0185]

FIG. 27 is a flowchart for explaining an operation example of the application server 110.

[0186]

The display condition input unit 2201 of the application server 110 receives an input of the display condition concerning a user to be displayed from a viewer (step 2701). As the display conditions, user name, user ID, department name, or floor name is specified. A plurality of user names or user IDs may be specified. When specifying user name or user ID, the viewer may further specify a name of the floor in which the viewer is present. In this case, in the case where it is determined that the user is present in a floor different from the viewer as a result of the position search processing, a message such as "Absence" is allowed to be displayed or a result of the position search processing is not displayed.

[0187]

Hereinafter, a case where the viewer instructs the application server 110 to display a user name "Taro Tanaka" will be described.

[0188]

The display condition input unit 2201 notifies the user information processing unit 2202 of the display condition specified by the viewer. The user information processing unit 2202 checks whether the received display condition is user name or user ID (step 2702).

If it is determined that the received display condition is user name or user ID as a result of

the check (YES in step 2702), the user information processing unit 2202 determines whether a single user or a plurality of users are specified in the display condition (step 2703).

If it is determined that only a single user is specified (YES in step 2703), the user information processing unit 2202 notifies the user information management unit 2203 of the user name or user ID.

On the bother hand, if it is determined that a plurality of user names are specified (NO in step 2703), the user information processing unit 2202 selects unprocessed one from a plurality of user names or user IDs specified as the display condition (step 2704) and notifies the user information management unit 2203 of the selected user name or user ID. In this example, user name "Taro Tanaka" is notified to the user information management unit 2203.

[0189]

The user information management unit 2203 that has received the user name or user ID searches for user terminal information corresponding to the notified user name or user ID (step 2705) and transmits the found user terminal information to the user information processing unit 2202 as a reply. In the example of FIG. 23, as a terminal corresponding to user name "Taro Tanaka", "tanaka_pc" is obtained as a search result and this "tanaka_pc" is notified to the user information processing unit 2202.

If it is determined that the user information management unit 2203 does not store the user terminal information corresponding to the notified user name or user ID, the user information management unit 2203 performs necessary error processing such as transmission of an error message (step 2716).

[0190]

If the user terminal information is notified from the user information management unit 2203 (YES in step 2706), the user information processing unit 2202 determines whether a plurality of user terminal information have been notified (step 2707).

[0191]

If it is determined that only a single user terminal information has been notified (YES in step 2707), the user information processing unit 2202 notifies the terminal information management unit 2204 of this user terminal information.

Upon receiving the notification of the user terminal information, the terminal information management unit 2204 searches the stored terminal information to extract the position information of the notified terminal (step 2708). In the example of FIG. 24, position information of user terminal "tanaka_pc" [F=2, X=10, Y=30], position accuracy [3m] and position acquisition time

[2003/1/10 17:20] are extracted by the terminal information management unit 2204.

[0192]

If the terminal information management unit 2204 does not store the position information of the notified terminal or it is determined that the position information needs to be reacquired (No in step 2709), the terminal information management unit 2204 performs update processing of the position information (step 2710).

For example, the terminal information management unit 2204 compares the acquisition time of the position of the specified user terminal with the current time when receiving the notification from the user information processing unit 2202. If this acquisition time is older than a predetermined time point, it is determined that the reacquisition of the position information needs to be performed. Assume that information 15 minutes or more before the current time is subject to update and the current time is [2003/10/10 17:40]. In this case, if the position acquisition time of the stored position information is [2003/1/10 17:20], it is determined that the reacquisition of the position information needs to be performed. With regard to the update method of the terminal information that the terminal information management unit 2204 stores, although the need of the update is determined when the display request is transmitted from the viewer in the above example, the application server may periodically perform the update processing of the position information. Further, in the case where the terminal type of the user terminal that the user information management unit stores is wired LAN terminal, the update processing of the position information need not be performed.

In the update processing of the position information, the terminal information management unit 2205 instructs the positioning server 109, through the positioning server interface unit 2206, to transmit the positioning of the terminal. Then the positioning server 109 transmits information specifying the terminal position to the positioning server interface unit 2206. The positioning server interface unit 2206 then transfers the information to the terminal information management unit 2205. The transferred information includes position information of the terminal, position accuracy, and the like. Upon receiving the information, the terminal information management unit 2205 updates position information, position accuracy, position acquisition time, and the like. A configuration may be adopted in which if the position identification processing fails, only the position acquisition time may be updated with columns of position information and position accuracy kept in blank or stored position information may not be updated.

[0193]

If the terminal information management unit 2205 acquires the position information of the

notified user terminal after the search processing of the terminal information or update processing of the position information stored therein, (YES in step 2711), the terminal information management unit 2205 transmits position information, position accuracy, position acquisition time to the user information processing unit 2202 as a replay.

If the terminal information management unit 2205 could not acquire the position information of the notified user terminal (NO in step 2711), the terminal information management unit 2205 performs necessary error processing (step 2716).

The user information processing unit 2202 may check whether a response from the terminal can be received in step 2711. In this case, a network protocol such as PING (Packet Internet Groper) may be used to check whether the terminal is normally connected to a network. In the case whether a response from the terminal could normally be acquired, it may be determined that the position information could not be acquired even though the position information is actually acquired.

[0194]

Since the position of the user specified by user name can be specified, the user information processing unit 2202 that has acquired the position information of the terminal from the terminal information management unit 2205 acquires display information represented by a text or corresponding floor map from the floor map management unit 2206 based on the acquired information, generates information in which an icon is displayed on the floor map, and transmits the generated information to the user position display unit 2207 to allow it to display the information (step 2712).

[0195]

The user information processing unit 2202 determines display of the position information of all users that have been specified is completed or not (step 2713). If processing of all users has been completed (YES in step 2713), this flow is ended. If processing of all users has not been completed (NO in step 2713), step 2704 and subsequent steps are repeated.

[0196]

The position information display processing in step 2712 may be performed for each user or after the position information acquisition processing of all users has been completed (YES in step 2713 or later). The user position display unit 2207 may display information indicating that the specified user is absent even in the case where the position information of the specified user could not be acquired. Further, in step 2701, a configuration may be adopted in which if a name of the floor in which the viewer is present is specified and acquired position information of the user differs from the floor in which the viewer is presented, display processing is not performed or information

indicating that the specified user is absent is displayed.

[0197]

The operation of the application server 110 in the case where the user specified by the viewer uses a plurality of terminals will be described using FIGS. 27 and 28. It is assumed in this example that user name "Jiro Sato" is specified.

[0198]

After the user information management unit 2203 has extracted the user terminal information corresponding to user name or user ID specified by the user information processing unit 2202, a plurality of user terminal information are obtained (NO in step 2707). In the example of FIG. 23, "sato_pc" and "sato_pc2" are specified as the user terminal information corresponding to user name "Jiro Sato". These user terminal information and terminal type are notified to the user information processing unit 2202.

[0199]

Upon receiving the notification, the user information processing unit 2202 checks whether a response from the respective terminals can be received (step 2801). In this case, a network protocol such as PING may be used to check whether the terminals are normally connected to a network.

[0200]

If a response could be received from the terminal (YES in step 2802), the user information processing unit 2202 extracts the user terminal that made a response normally (step 2803) and notifies the terminal information management unit 2204 of the extracted user terminal.

Upon receiving the notification, the terminal information management unit 2204 searches whether the position information of the user terminal is held or not and determines whether update of the position information is necessary or not (step 2805).

If it is determined that update of the position information is necessary (NO in step 2805), the position information is updated (step 2806). The processing in steps 2805 and 2806 are the same as those in steps 2709 and 2710.

[0201]

If it is determined that update of the position information is not necessary, or if the position information of the user terminal could be acquired after the update of the position information (YES in step 2807), the terminal information management unit 2204 determines whether only a single user terminal could acquire the position information (step 2808).

If it is determined that only a single user terminal could acquire the position information

(YES in step 28708), the terminal information management unit 2204 selects the position information of the single user terminal (step 2809).

On the other hand, if it is determined that a plurality of user terminals could acquire the position information (NO in step 2808), terminal information management unit 2204 determines whether the position information of the user terminal whose terminal type is a wireless LAN terminal could be acquired (step 2810).

If the position information of the user terminal whose terminal type is a wireless LAN terminal could be acquired (YES in step 2810), the terminal information management unit 2204 selects the position information of the above user terminal (step 2811). In the case where a plurality of user terminals whose terminal type is a wireless LAN terminal in step 2811, the terminal information management unit 2204 selects one from them. In this case, the terminal information management unit 2204 may collect information, such as a key input operation, indicating the operation state of the terminal and select the position information of the user terminal on which a key input operation is made most recently.

If the position information of the user terminal whose terminal type is a wireless LAN terminal could not be acquired (NO in step 2810), the terminal information management unit 2204 selects the position information of the user terminal whose terminal type is a wired LAN terminal (step 2812). In the case where there are a plurality of user terminals in step 2812, the terminal information management unit 2204 selects one from them. In this case, the terminal information management unit 2204 may collect information, such as a key input operation, indicating the operation state of the terminal and select the position information of the user terminal on which a key input operation is made most recently.

[0202]

The operation of the application server 110 in the case where the viewer specifies department name as the display condition will be described using FIGS. 27 and 28.

[0203]

In the case where the viewer specifies the display by department name in the display condition input unit 2201 (YES in step 2714), the user information processing unit 2202 transmits a request to the user information management unit 2203 for a list of users corresponding to the specified department name.

Upon receiving the request, the user information management unit 2203 searches the managed information using the department name as a key and acquires a list of users corresponding to the department name and a list of user terminals of the users (step 2901).

If there is any user belonging to the specified department (YES in step 2902), the user information processing unit 2202 acquires the position information of the user terminal of the user (step 2903). The acquisition method of the position information of the user terminal in step 2903 of FIG. 29 is the same as those described in steps 2706 to 2711 of FIG. 27 and FIG. 28.

In order to display the position information of the users, the user information processing unit 2202 that has acquired the position information of the user belonging to the specified department acquires display information represented by a text or corresponding floor map from the floor map management unit 2206, generates information in which an icon is displayed on the floor map, and transmits the generated information to the user position display unit 2207 to allow it to display the information (step 2904).

[0204]

The operation of the application server 110 in the case where the viewer specifies floor name as the display condition will be described using FIGS. 27 and 30.

[0205]

In the case where the viewer specifies the display by floor name in the display condition input unit 2201 (YES in step 2715), the user information processing unit 2202 transmits a request to the floor map management unit 2206 for a floor ID corresponding to the specified floor name (step 3001).

[0206]

If the floor ID corresponding to the specified floor name could be acquired (YES in step 3002), the user information processing unit 2202 transmits a request to the terminal information management unit 2204 for a list of user terminals corresponding to the acquired floor ID. Upon receiving the request, terminal information management unit 2204 searches the managed terminal information using the floor ID as a key and acquires a list of user terminals corresponding to the floor ID and a list of position information of the user terminal, position accuracy information, and the like (step 3003), and transmits them to the user information processing unit 2202 as a reply.

If there is any user terminal corresponding to the specified floor ID (YES in step 3004), the user information processing unit 2202 that has received the user terminal information transmits a request to the user information management unit 2203 for the user information corresponding to the acquired user terminal.

Upon receiving the request, the user information management unit 2203 searches the managed user information using the user terminal information as a key (step 3005) and transmits the relevant user name, terminal type of the user terminal, and the like to the user information

processing unit 2202 as a replay.

In order to display the position information of the users, the user information processing unit 2202 that has acquired the user name that uses the user terminal extracted in step 3003 (YES in step 3006) acquires display information represented by a text or corresponding floor map from the floor map management unit 2206, generates information in which an icon is displayed on the floor map, and transmits the generated information to the user position display unit 2207 to allow it to display the information (step 3007).

[0207]

The creation of the display information from the position information of the user performed by the user information processing unit 2202 in step 2712 of FIG. 27, step 2904 of FIG. 29, and step 3007 of FIG. 30 will be described in more detail using FIG. 31.

[0208]

As described above, the user information processing unit 2202 generates display information represented by a text or information in which an icon is displayed on the floor map and transmits the generated information to the user position display unit 2207 to allow it to display the information. In the case where the user position is displayed on the floor map using an icon, it is possible to express accuracy of the information by selectively using a display method according to the position accuracy information or positioning technique information associated with the acquired position information.

In the example of FIG. 31, a difference in the positioning accuracy information is expressed between an icon 3102 indicating user "Taro Tanaka" and an icon 3103 indicating user "Jiro Sato" which are disposed on a floor map 3101 by circling the icon 3102 indicating user "Taro Tanaka". Further, the present position of the viewer may be displayed on the floor map. For example, a present position 3105 is displayed on the floor map in the example of FIG. 31. In order to display the present position of the viewer, a method may adopted in which the installation position of the application server or installation position of the terminal that accesses the display condition input unit 2201 and user position display unit 2207 is previously registered, or in which the display condition input unit 2201 acquires the terminal information of the terminal that has accessed the display condition input unit 2201 and user information processing unit 2202 inquires to the terminal information management unit about the position information of the viewer's terminal.

[Third Embodiment]

[0209]

As is clear from the above description, the positioning server according to the present

invention can be realized not only by hardware, but also by a computer program.

[0212]

FIG. 21 is a block diagram showing a configuration example of an information processing system that implements the positioning server according to the present invention.

[0211]

The information processing apparatus shown in FIG. 21 includes a processor 2101, a program memory 2102, and a recording medium 2103. As the recording medium, a magnetic recording medium such as a hard disk can be employed.

[Brief Description of Drawings]

[0212]

[FIG. 1] A view showing a configuration example of the present invention.

[FIG. 2] A view showing a configuration example of an illumination device in the present invention.

[FIG. 3] A configuration example of a light signal detection unit in the present invention.

[FIG. 4] A view showing a configuration example of a terminal in the present invention.

[FIG. 5] A view showing a configuration example of a positioning server in the present invention.

[FIG. 6] A view showing a configuration example of a transmission unit and light emission unit of the illumination device in the present invention.

[FIG. 7] A view showing a configuration example of a transmission LED of the illumination device in the present invention.

[FIG. 8] A view showing a configuration example of the transmission unit of the illumination device in the present invention.

[FIG. 9] A view showing a configuration example of a transmission area of unique signal that the illumination device transmits in the present invention.

[FIG. 10] A time chart showing an example of a signal flow in the present embodiment.

[FIG. 11] A view showing an example of output power control that a signal synthesis unit performs based on unique information in the present invention.

[FIG. 12] A flowchart showing an example of a process flow of the positioning server in the present invention.

[FIG. 13] A table showing an example of information stored by a terminal information storage unit of the positioning server in the present invention.

[FIG. 14] A table showing an example of information stored by an illumination installation position database of the positioning server in the present invention.

[FIG. 15] A view showing another configuration example of the positioning server in the present invention.

[FIG. 16] A table showing another example of information stored in a terminal information storage unit of the positioning server in the present invention.

[FIG. 17] A table showing an example of information stored in a base station installation position database of the positioning server in the present invention.

[FIG. 18] A flowchart showing another example of a process flow of the positioning server in the present invention.

[FIG. 19] A view showing a configuration example of an illumination module part of the illumination device in the present invention.

[FIG. 20] A view showing a configuration example of the illumination module part in which an interface of an existing fluorescent tube is used as a connection interface.

[FIG. 21] A view showing a configuration example of an information processing apparatus in the present invention.

[FIG. 22] A view showing a configuration example of the application server in the present invention.

[FIG. 23] A table showing a configuration example of user information in the present invention.

[FIG. 24] A table showing a configuration example of terminal information in the present invention.

[FIG. 25] A table showing a configuration example of floor information in the present invention.

[FIG. 26] A view showing an example of a floor map in the present invention.

[FIG. 27] A flowchart for explaining the operation in the present invention.

[FIG. 28] A flowchart for explaining the operation in the present invention.

[FIG. 29] A flowchart for explaining the operation in the present invention.

[FIG. 30] A flowchart for explaining the operation in the present invention.

[FIG. 31] A view showing an example of display information in the present invention.

[FIG. 32] A block diagram showing another configuration example of the illumination device in the present invention.

[FIG. 33] A configuration example of the illumination device in the present invention.

[FIG. 34] A view showing a configuration example of an illumination module part of the illumination device in the present invention.

[FIG. 35] A view showing a configuration example of a straight fluorescent tube.

[FIG. 36] A detailed configuration example of the illumination device in the present invention.

[FIG. 37] A view showing an internal configuration example of a straight fluorescent tube.

[FIG. 38] A view showing a configuration example of a power acquisition unit.

[FIG. 39] A view showing a state where the power acquisition unit is attached to the straight fluorescent tube.

[FIG. 40] A configuration example of a power conversion unit.

[FIG. 41] A configuration example of a straight fluorescent tube and connector.

[Reference Sign List]

[0213]

101, 105: Terminal

102, 106: Base station

103, 107: Illumination device

104, 108: Light signal detection unit

109: Positioning server

110: Application server

[Name of Document] ABSTRACT

[Abstract]

[Subject] In order to perform accurate positioning using a wireless LAN, three or more wireless LAN base stations need to be seen by a positioning target terminal. However, in the wireless LAN, where base stations are not installed under the design of providers unlike the case of a cellular system but are often installed at irresponsible locations, there is no guarantee that the positioning target terminal can see three or more base stations. In a positioning system using a weak radio wave, such as a Bluetooth or RFID system, it is possible to achieve pinpoint positioning while it is necessary to install a large number of communication modules conforming to Bluetooth or RFID to walls and a ceiling, increasing installation cost.

[Solving Means] In the present invention, an illumination device includes a function for transmitting unique information; a terminal includes means for transmitting the unique information of the illumination device to a position server; and the position server includes a function for identifying a position of the terminal by searching an illumination installation position database based on the unique information.

[Selected Drawing] Fig. 1